SPIXIANA	16	2	133–139	München, 1. Juli 1993	ISSN 0341-8391

The wing coupling apparatus in *Peloridium hammoniorum* Breddin, 1897 *

(Insecta, Rhynchota)

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D'Urso, V. (1993): The wing coupling apparatus in *Peloridium hammoniorum* Breddin, 1897 (Insecta, Rhynchota). - Spixiana **16/2:** 133-139

Light microscope and S.E.M. observations were performed on the wing coupling apparatus in the Rhynchota *Peloridium hammoniorum* Breddin. The main structure of this apparatus is Heteropterous type. It has a complex structure in the fore wings (FWC) situated on the ventral surface of the clavus on the PCu+1A vein. This structure consists of an outer portion (PO) formed by a protuberance carrying 25-30 long, flat, densely packed microsculptures and an inner portion (PI) separated from the outer one by a groove (G) formed by a prominence covered by about 20 spine-like microsculptures. A double longitudinal fold (HWC) complementary to the mesothoracic coupling structure runs along the costal margin of the hind wings.

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Introduction

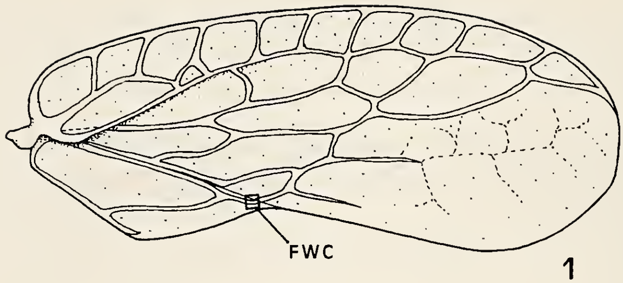
The Peloridiidae (Coleorrhyncha) are a family of Rhynchota found only in South America and the Australian region (Australia, New Zealand, Tasmania) and therefore having a typical Gondwana distribution. At present this family contains 25 species belonging to 13 genera. They are sedentary Insects that require a high degree of humidity and live in moss and bog moss and almost all of them unable to fly.

This group's taxonomical position in Rhynchota is still uncertain and open to discussion. In fact, it exhibits some features of Heteroptera and others of Homoptera, all of which are diversely interpreted and evaluated.

The family described in 1897 by Breddin for the *Peloridium hammoniorum* species was attributed to the Heteroptera until the end of the 1920s. It was then assigned to the Homoptera and a new series called Coleorrhyncha was instituted for it (Myers & China 1929). More recently Schlee (1969) reported that some of the antenna, wing abdominal segment, anal cone and aedeagus characters should be considered synapomorphies with the Heteroptera. This would support the monophyletic origin of Heteroptera and Coleorrhyncha which this Author calls Heteropteroidea. Hennig (1981) confirms the monophyletic origin of these two groups in his book "Insect Phylogeny".

Although the Peloridiidae are a key group for Rhynchota phylogeny, the information available on their morphology is far from sufficient (Myers & China 1929; Evans 1938, 1939, 1981; Woodward 1956; China 1962; Singh 1971). Interpretation of their morphological wing data are conflicting, especially regarding cubital, anal fore wing veins (Evans 1939, Woodward 1956, Davis 1961, China 1962, Wootton 1965, Hennig 1981). *Peloridium hammoniorum* which is widespread in South Chile and Argentinean Patagonia is indubitably the most studied species. This species features both long and short winged

* Financial assistance was provided by the 60 % MURST.



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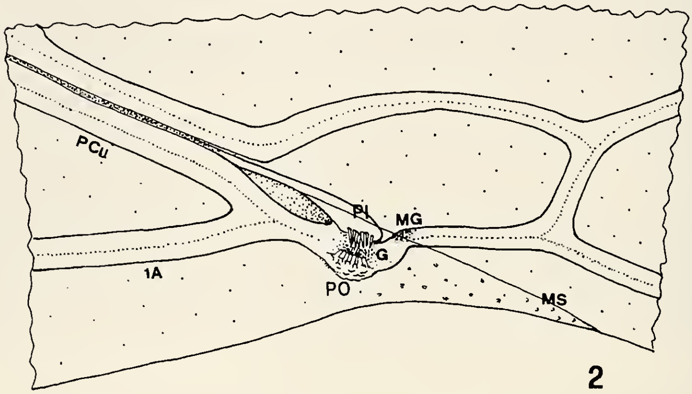

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Figs 1-2. *Peloridium hammoniorum*, left fore wing, ventral surface. 1. In toto. 2. Detail with the wing coupling mesothoracic structure (FWC) (Abbr. in text).

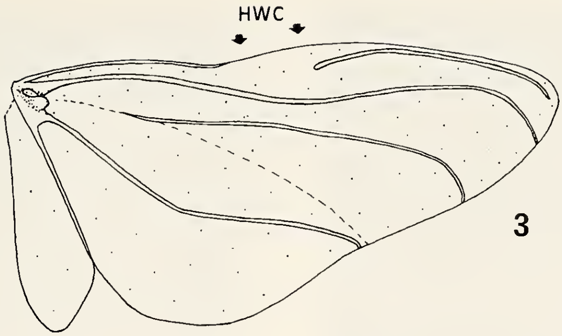
males and females, the macropterous forms having developed, functional wings which enable them to fly.

China (1962) is the sole Author who has reported information on the mechanism of the in flight anterior and posterior wing coupling apparatus of the same side in Peloridiidae. He described this mechanism in macropterous forms of *Peloridium hammoniorum* as heteropteroid type, situated on the PCu+1A vein tip (corresponding with Wootton's 1A+2A and Evans' Cu2+1A+2A) near the apex of clavus and consisting of an inner tubercle crowned by a group of rather thick, contiguous and more or less fused setae directed towards the costal margin. These are opposed by a group of slender setae stemming from contiguous, spheric tubercles and pointing towards the anal margin. The hind wing posterior margin is presumably gripped between the two thick and slender setae.

Although China (1962) remarked that this apparatus resembled the typical one found in Heteroptera but was quite different from the characteristic Homoptera one, he did not pay much attention to this character and placed Peloridiidae in the Homoptera. He supplied a schematic illustration of the coupling apparatus which is the only one available for the Peloridiidae up to date. This induced me to carry scanning electron microscope (S.E.M.) studies to furnish a detailed description of the coupling device in *Peloridium hammoniorum* in order to perform a comparative analysis of the typical wing coupling devices in Heteroptera and Homoptera.

Materials and methods

This study is based on light microscope and S.E.M. observations of the wing coupling mechanism of specimens of *Peloridium hammoniorum* from Tierra del Fuego. For light microscopic studies the wings were removed and then



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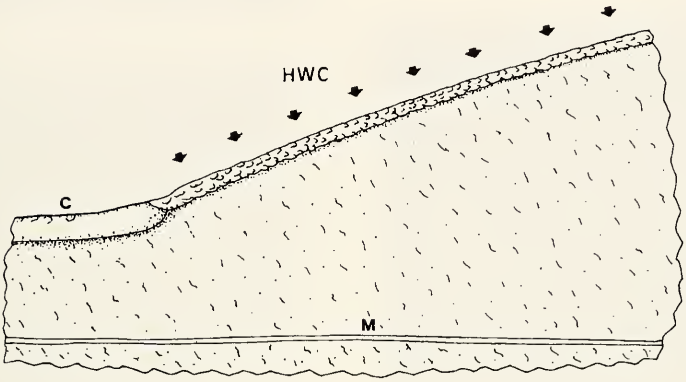

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Figs 3-4. *Peloridium hammoniorum*, right hind wing, dorsal surface. 3. In toto. 4. Detail with the wing coupling metathoracic structure (HWC) (Abbr. in text).

cleaned with the same technique used for pieces observed under the S.E.M. The intact wings were then mounted on slides and removed after observation. S.E.M. material was treated with standard preparation methods (cleaning, dehydration with increasing series of al alcohol, mounting on stubs, metallization with 18K gold paint) prior to observation using a JSM 35R. Tensioactive chemical substances were used for cleaning instead of ultrasound as the latter often damage the delicate wing membranes.

The vein terminology used is the one proposed by Davis (1961) and China (1962).

List of the abbreviations

1A - first anal vein; 2A - second anal vein; C - costa; Cu2 - cubitus 2nd; FWC - wing coupling structure of the fore wing; G - mesothoracic wing groove; GI - inner metathoracic wing groove; GO - outer metathoracic wing groove; HWC - wing coupling structure of the hind wing; M - media; MG - granular mesothoracic wing microsculptures; MS - scale-like mesothoracic wing microsculptures; PCu - cubitus posterior; PI - inner part of the wing coupling mesothoracic structure; PO - outer part of the wing coupling mesothoracic structure.

Results

The wing coupling apparatus between the fore and hind wings in *Peloridium hammoniorum* is formed by a complex structure on the fore wing ventral surface which grips a double longitudinal fold along the hind wing costal margin.

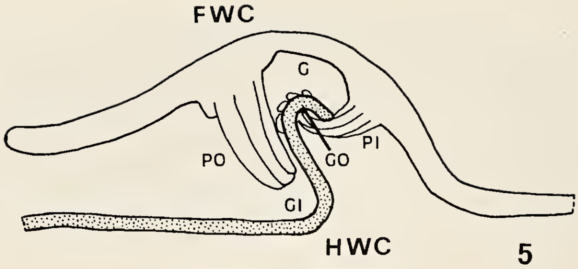


Fig. 5. *Peloridium hammoniorum*, outline of the wing coupling mechanism. Fore wing in white and hind wing in black dots (Abbr. in text).

Mesothoracic wings

The wing coupling structure of the fore wings (FWC) (Figs 1, 2, 6-11) is situated in the clavus near the apex on the vein that originates from the fusion of PCu and 1A. This structure has an internal and external part which are separated by a deep groove.

The **external portion** (PO) (Figs 2, 6-11) is made up of a protuberance which is crowned by 4 or 5 series (25-30) very long, flattened, round tipped and densely packed microsculptures. They are often directed inwardly and ventrally curved. One or two series of similar, but much shorter, microsculptures are present on the external protuberance surface near the area the longer ones arise from.

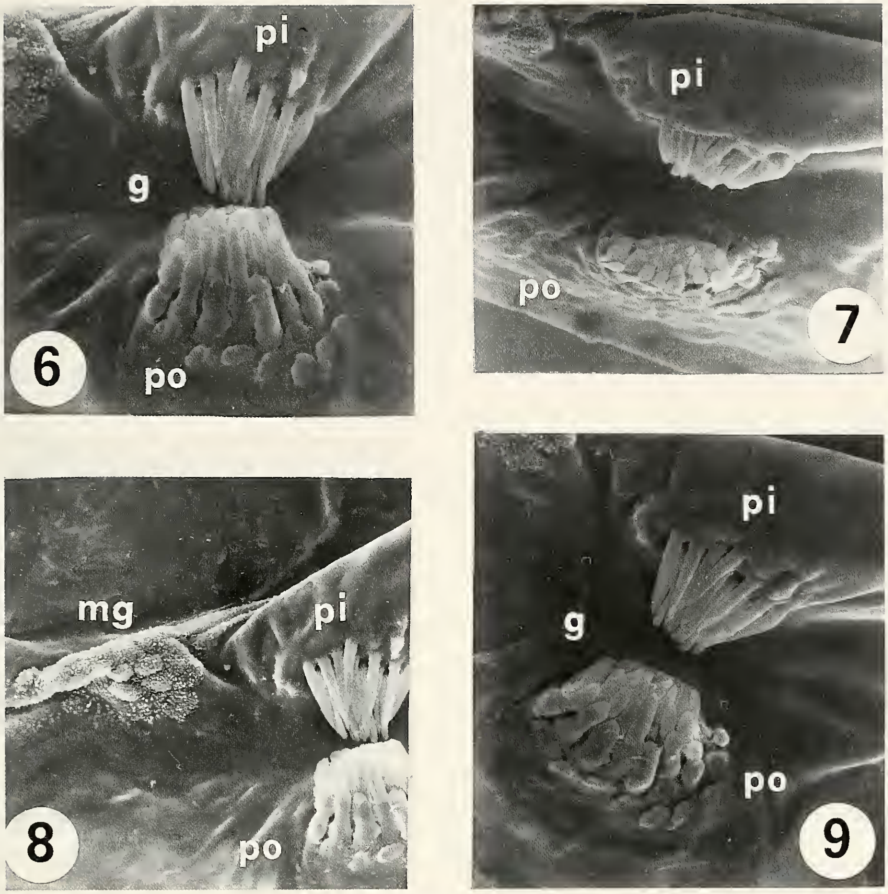
The **internal portion** (PI) (Figs 2, 6-11) lies opposite the external one and they are separated by a groove (G) (Figs 2, 6-11). It is formed by a ridged area crowned by a group of about 20 spine-like, posteriorly and ventrally directed microsculptures. These are more curved than the external portion microsculptures and therefore lie on a more ventral plane than the latter. Scattered pits are found on the wing membrane between the external portion of the wing coupling device, the anal margin and the claval suture. Rounded, apical-pointing, scale-like microsculptures (MS) (Fig. 2) are present nearer the apex of clavus.

An irregularly raised area densely covered by slender granular microsculptures (MG) (Figs 2, 8) is found on the PCu+1A vein and along the claval suture distally to the wing coupling device aligned with its internal portion.

Metathoracic wings

There is a hind wing coupling structure (HWC) (Figs 3, 4, 12, 13) complementary to the one on the fore wings. The costal margin forms a very long double longitudinal groove which arises proximally from the distal tip of the costa and ends at the level of posterior third of the wing margin. This longitudinal groove stems from a double curvature of the wing surface near the costal margin and has an S-shaped cross section. It folds internally and dorsally giving rise to a long groove which I call inner groove (GI) (Fig. 13), before turning once again ventrally and externally to form another parallel groove which I call outer groove (GO) (Fig. 13). Three-four series of scale microsculptures are found at the level of the convex surface of the external groove up to free margin. They are either more or less halfmoon shaped or quadrangular and are concave in the centre and equipped with small grooves. Their free margin is directed towards the interior of the wing and is rounded with few protrusions. In the centre of the longitudinal groove the scales are larger and more numerous. The other parts of the dorsal surface and the ventral portion of the double longitudinal groove are smooth. The proximal and distal tips of this fold are modified and tend to lose the double curvature and consequently the characteristic S-shaped section. The scales become smaller, more simple and thinner, this being most evident on the distal tip. The proximal tip arises from the thickest portion of the wing margin formed by the costa, and the scales cover a narrow, progressively widening band along the border.

There are widespread, typical microsculptures on the wing membrane over the entire dorsal wing surface and near the double groove. These microstructures form small crests which are tapered at the two tips and have rounded, free margins.



Figs 6-9. *Peloridium hammoniorum*, wing coupling structure of the fore wing (FWC) (6,7,9:580X; 8:450X). (Abbr. in text).

Discussion

During the transition from the resting to the flight position the fore wing movement on the hind wings allows reciprocal wing coupling by means of the wing coupling device so that the wings on each side function as a single unit.

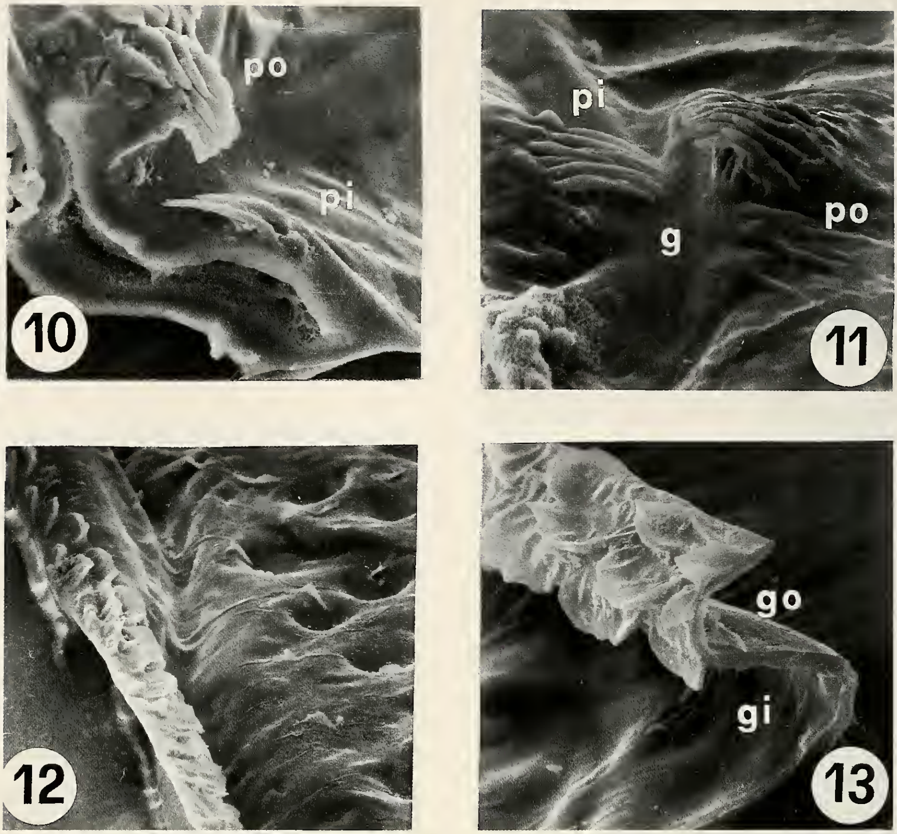
The fore wing coupling apparatus is so shaped that grips the double metathoracic fold and slides back and forewards during flight before uncoupling at the end. The outer portion of the FWC runs along the inner metathoracic groove, while the inner portion slides along the outer one (Fig. 5).

The double curvature of the metathoracic fold and the microsculptures on part of its dorsal surface determine greater adhesion between the fore and hind wings during flight and reduce the risk of early uncoupling. The microsculptures on the wing surface near the mesothoracic coupling apparatus could play a similar role.

S.E.M. examination revealed that the inner mesothoracic portion does not present "setae" arising from spherical tubercules as reported by China (1962) but has only spine-like microsculptures without a swollen base. It also showed that the structures on the outer portion cannot be defined as setae.

No traces of wing coupling device were observed on short wing specimens.

The wing coupling main structure observed in *Peloridium hammoniorum* greatly resembles the one present in Heteroptera. The FWC outer portion corresponds with Heteroptera "pad" (Chu 1971, Wood



Figs 10-13. *Peloridium hammoniorum*. 10, 11. Wing coupling structure of the fore wing (FWC) (580X). 12, 13. Wing coupling structure of the hind wing (HWC) (12: 540X; 13: 1270X). (Abbr. in text).

1979) or " sliding head" (Schneider & Bohne 1977) or "Gleitkopf" (Schneider & Schill 1978), while the inner corresponds with their "spinaculum" (Chu 1971, Wood 1979) or "sliding comb" (Schneider & Bohne 1977) or "Gleitkamm" (Schneider & Schill 1978). The double metathoracic fold corresponds with the similar structure on the Heteroptera's hind wing costal margin called the "S-shaped sliding fold" (Schneider & Bohne 1977) or "Gleitfalz" (Schneider & Schill 1978).

The differences are determined by the fine morphology of the various parts forming the coupling apparatus, i. e. shape and number of microsculptures in the inner and outer portions of the FWC and the shape of the microsculptures in the HWC.

The arrangement of the coupling parts in the wing coupling apparatus in *Peloridium hammoniorum* is totally different from the one found in Homoptera. The latter have one or two hooks (Sternorrhyncha), or a lobe or longitudinal fold (Auchenorrhyncha) along the hind wing costal margin which grip a longitudinal fold in the fore wing posterior margin. Therefore, in Homoptera the coupling portion is always represented by one, or a series of, structures but never by two interlocking portions. In addition the coupled portion is always a plain fold and never S-shaped.

The wing coupling device main structure in *Peloridium hammoniorum* may be the primitive one common to all the Coleorrhyncha, even if this is the only species with long fore and hind wings known. China (1962) believes that the existence of forms with long wings capable of flight in *Peloridium* (or one of its predecessors) may make it the common ancestor which gave rise to the present day genera due to its diffusion from an Antarctic area in the Permian.

The *Peloridium hammoniorum* wing coupling device main structure and finer morphology revealed by S.E.M. may support Schlee's hypothesis of the monophyletic origin of Heteroptera and Coleorrhyncha.

In fact, it must be underlined that the wing coupling apparatus main structure is a constant character within large groups. Although Heteroptera and Coleorrhyncha on one side and Homoptera Auchenorrhyncha and Sternorrhyncha on the other have different structural planes, they are homogeneous within their own groups. At present there is not sufficient data to attribute the Peloridiidae to the Homoptera or Heteroptera with certainty. According to Evans (1981) Peloridiidae should be considered a systematic group comparable to Heteroptera and Homoptera groups.

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